ON INTELECTELESUATION OF OPERATIONAL AND EMERGENSY AUTOMATION CONTROL OF “POWER BRIDGE AGT”

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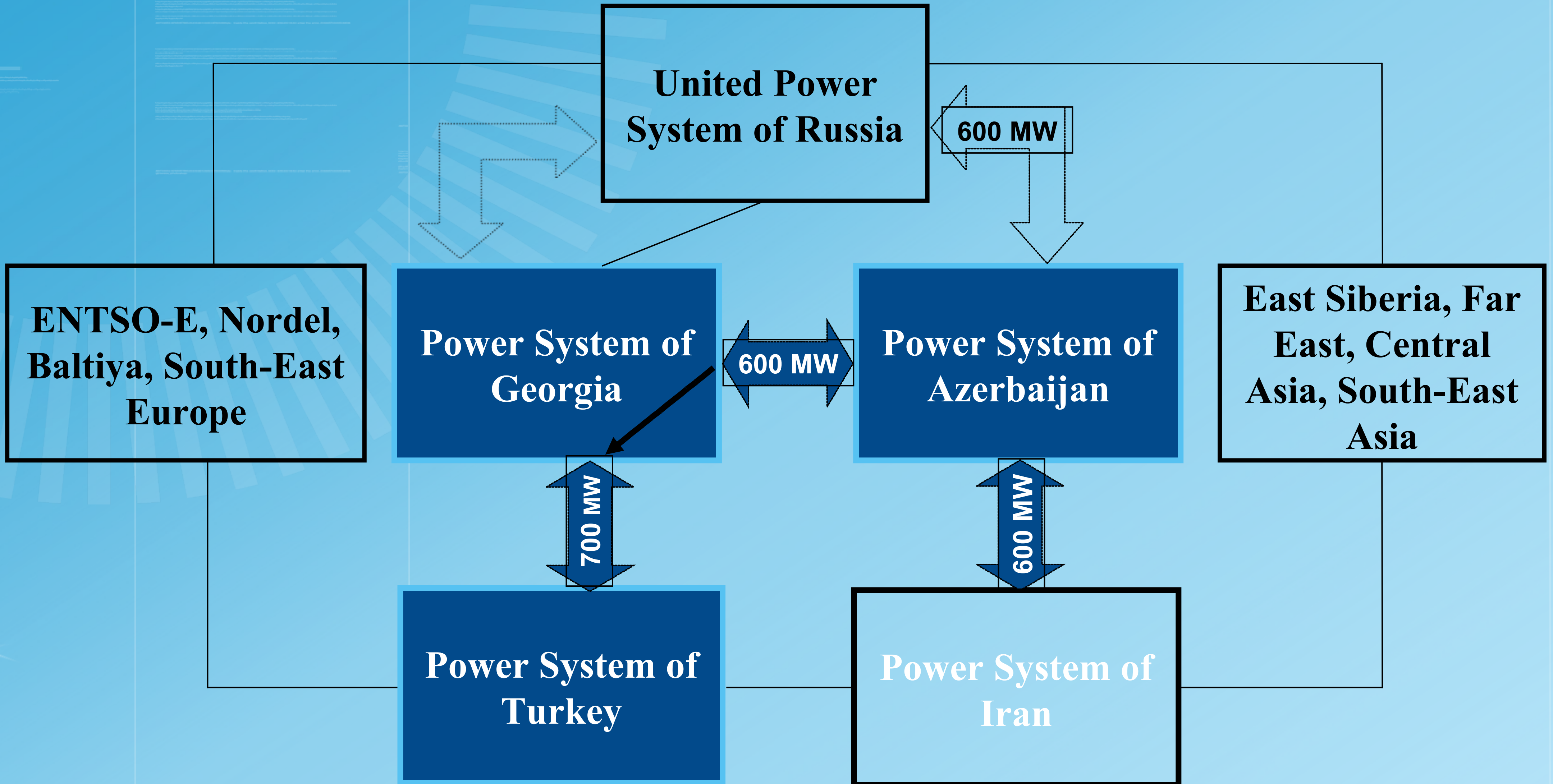
MAIN SUBJECTS

I. Analysis of the current situation of large-scale PG in the world, the main principles of strategy of PGs connection and also information about main parameters of Azerbaijan's PS in brief;

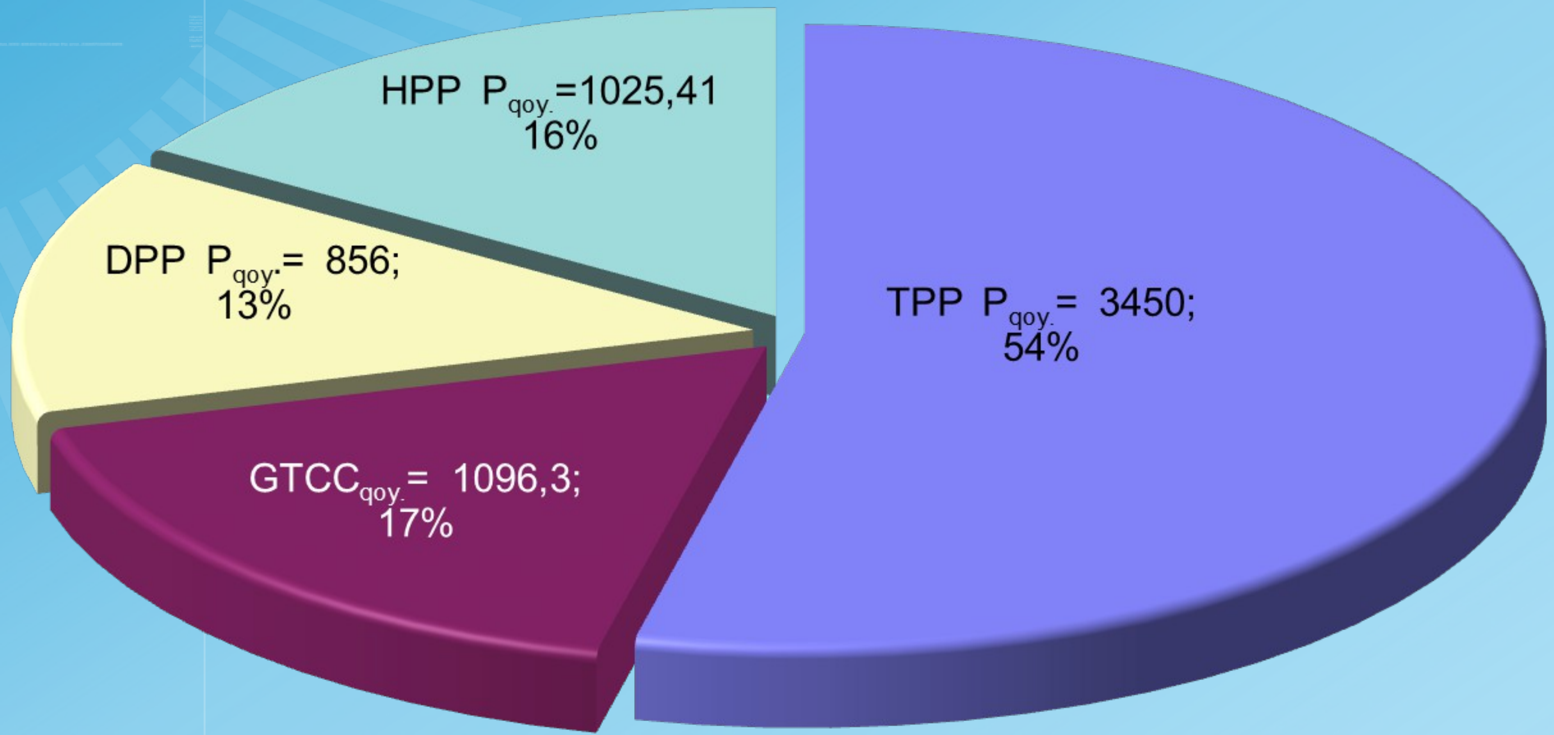
II. Modern principles of intelligent control of PG, means of measurement and control systems and it's implementation possibility in the "PB project AGT"

III. Estimation of intensity process in case of large disturbance in elements of PG.

BLOCK DIAGRAM OF THE INTERSTATE LINKS

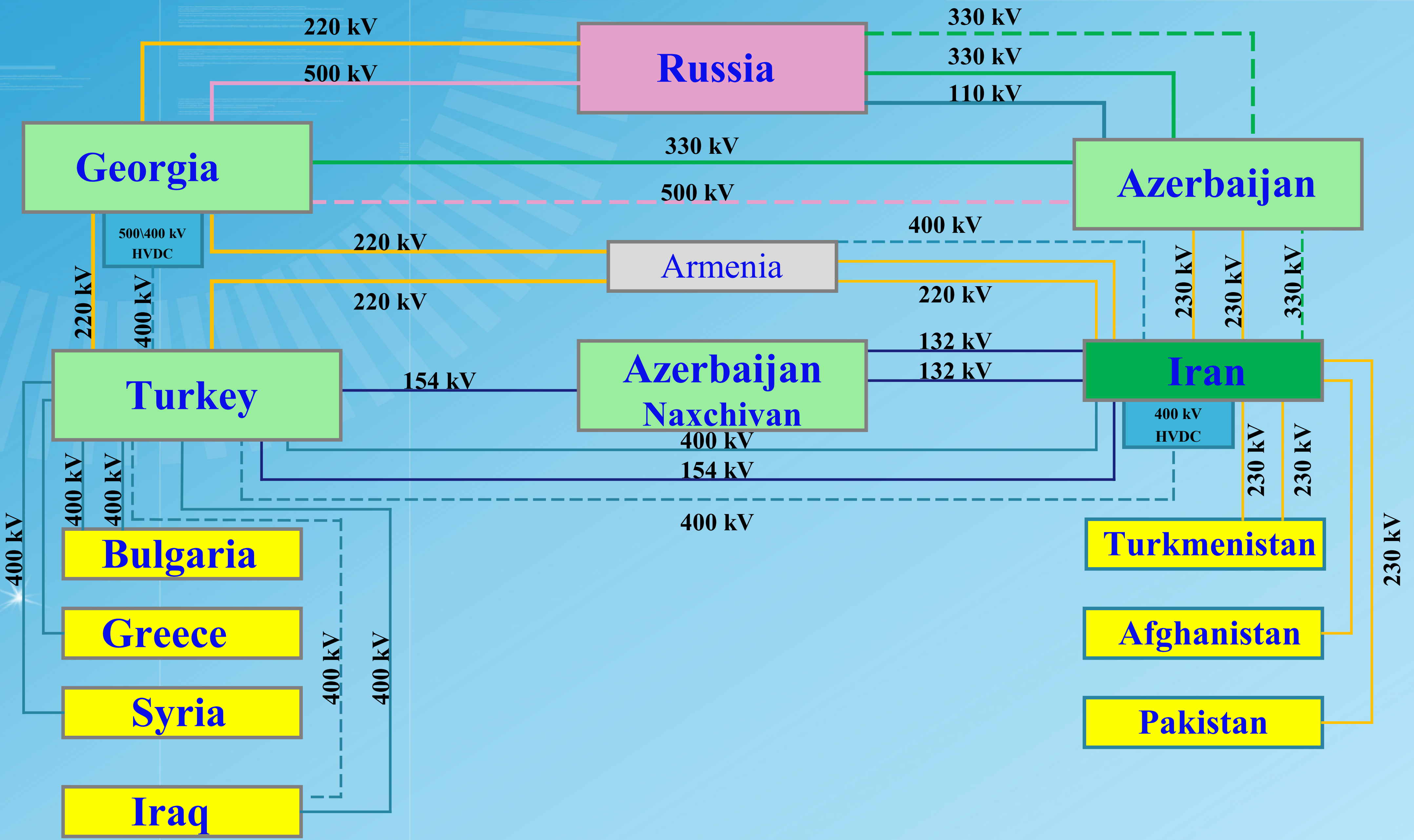


STRUCTURE OF GENERATION



$$\Sigma P_{inst.capac.} = 6.5\ GW$$

DIAGRAM OF POWER INTERCONNECTIONS IN THE CAUCASUS REGION



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DISADVANTAGES OF SCADA SYSTEMS

- They are able to implement only Supervisory control and data acquisition
- SCADA systems is not a complete control system
- SCADA systems provide steady non-synchronous information of the power system with time resolution between 1 and 10s.
- SCADA systems have limited steady state measurements and can not served for dynamics calculation
- RTU scan incoming data at high speed, main computer scans the remote terminals, typically at a lower speed
- Limited the ability of the messages with complex devices
- Often there is a dependence on a specific hardware manufacturer
- The security problems appear during the expansion of SCADA system and so on

Vector measurement SCADA

$$Y_s = [\, P_{gi}\, Q_{gi}\, P_{lj}\, Q_{lj}\, V_{ij} \,]$$

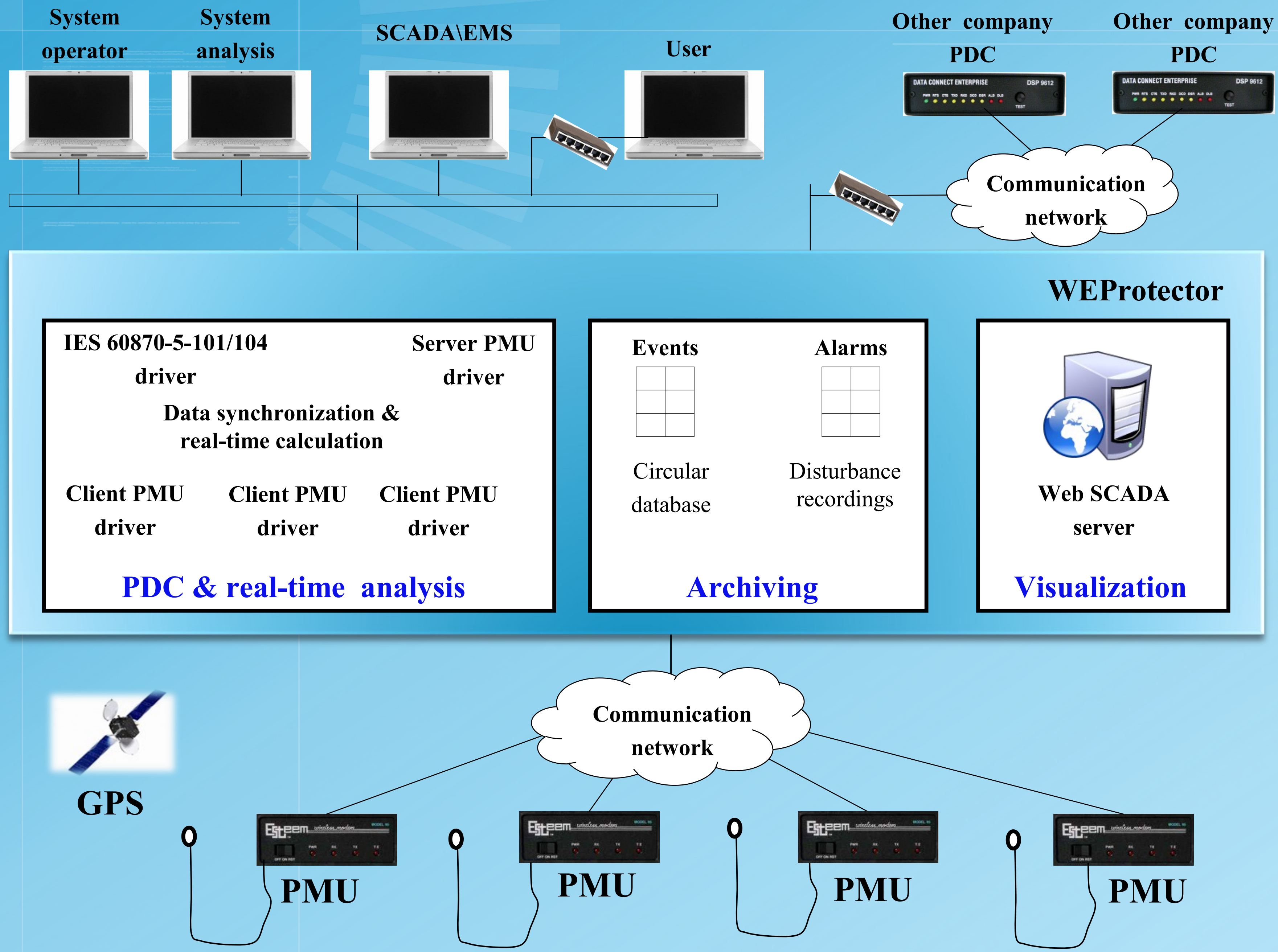
where $P_{gi}\, Q_{gi}$ - active and reactive power generators,
P_{lj} ,Q_{lj} – active and reactive load flows of lines,
V_{ij} - voltage modules in nodes.

Vector measurement “SCADA + PMU”

$$Y_{pmu} = [P_{gi}\, Q_{gi}\, P_{lj}\, Q_{lj}\, V_{ij}\, I_{ij}\, \varphi_{ij}\, \delta_{ij} \,]$$

where φ_{ij} - voltage phase,
δ_{ij} – current phase.

THE CONFIGURATION SIMULTANEOUS CONNECTION WAMS + SCADA



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MM OF PG (IN THE CASE OF STATIONER LINEAR SYSTEM)

$$px(t) = Ax(t) + Bu(t), \qquad y(t) = Cx(t)$$

where $x(t)$ – vector of power state variables (nx1);

$u(t)$ – vector of input controlling influences (mx1).

$y(t)$ – vector of output controlled variables (qx1);

[A], [B], [C] – matrices of power state (nxn), matrix input variables (nxm) and matrix of output (qxn) correspondingly

Criteria of observability and controllability

$$N_c = [\ B\ AB\ A^2B \ldots A^{n-1}B\ ]$$

$$N_e = [\ C^t\ \ A^tC^t\ \ (A^t)^2 C^t \ldots C^t (A^t)^{n-1}\ ]$$

$$\det N_c \neq 0, \quad \det N_e \neq 0, \quad r = n$$

MATHEMATICAL MODEL OF PG IN VARIABLE STATE

$[P\Delta x]=[\ p\Delta\delta,\ p\Delta\omega,\ p\Delta E'_q,\ p\Delta E_{qe}\ ,\ p\Delta U_p,\ p\Delta У_1,\ \ p\Delta У_2,\ p\Delta У_{3,}\ p\Delta У,\ p\Delta У_{об}]^t$

$[Y]=[\Delta\delta,\ \Delta\omega,\ \Delta E'_q,\ \Delta E_{qe},\ \Delta U_p,\ \Delta У_1,\ \Delta У_2,\ \Delta У_3,\ \Delta У,\ \Delta У_{об}]^t$

$[B]=[\ -1/T_J,\quad 1/T_J]^t$ $\qquad\qquad$ $[U]=[\Delta P_T,\ \Delta U_{BH}]^t$

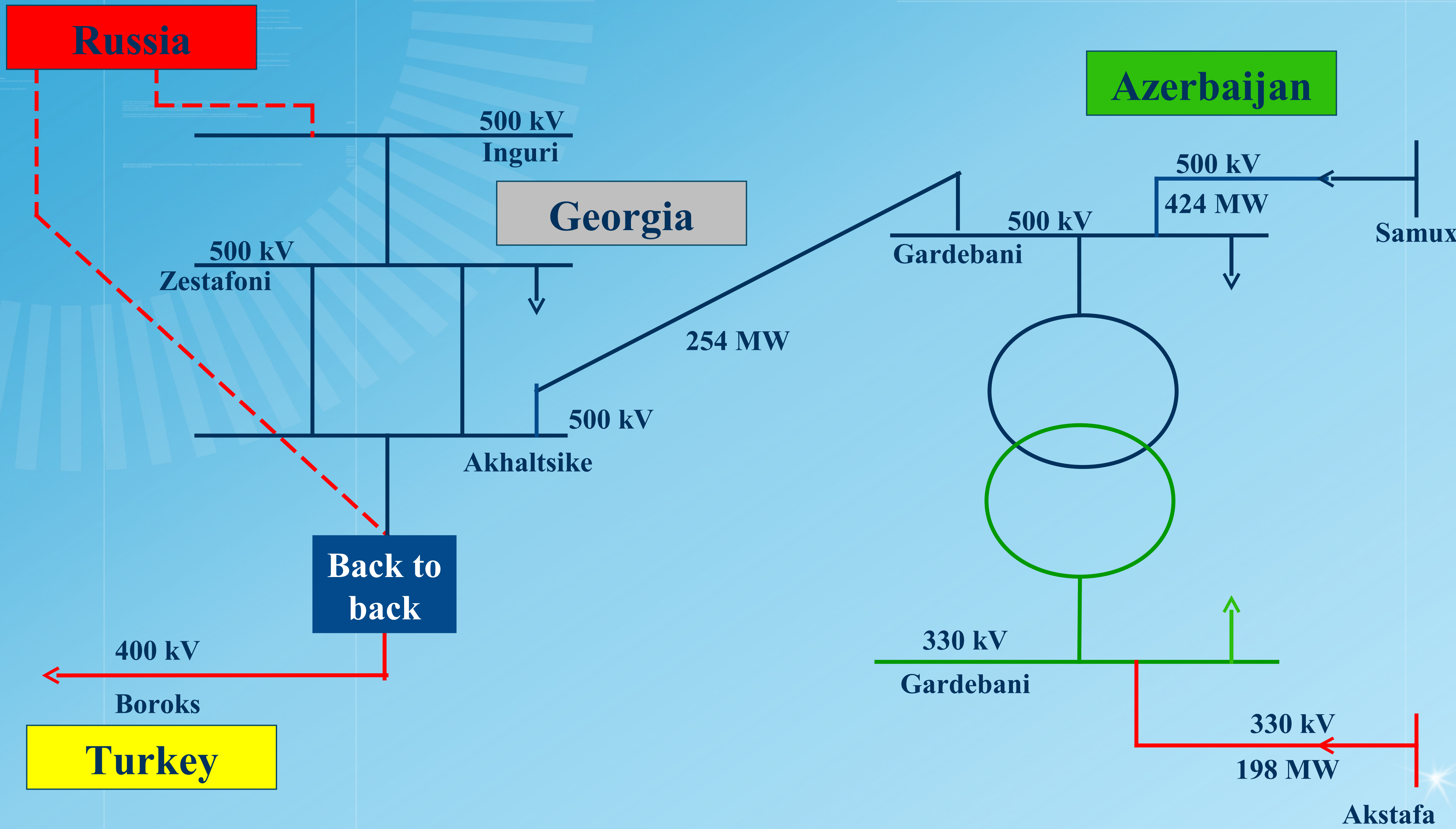
[A] =

	1								
$-\frac{1}{T_J}K_1$		$-\frac{1}{T_J}K_2$							
$-\frac{1}{T_{do}}K_4$		$-\frac{1}{T_{do}K_3}$	$\frac{1}{T_{do}}$						
			$-\frac{1}{T_e}$	$-\frac{1}{T_e}$					
$\frac{1}{T_p}t$		$\frac{1}{T_p}s$	$-\frac{1}{T_p}K_{об}$	$-\frac{1}{T_p}$	$\frac{1}{T_p}$	$\frac{1}{T_p}$	$\frac{1}{T_p}$	$\frac{1}{T_p}K_f$	$-\frac{1}{T_p}$
$-\frac{1}{T^2_g}K_{1u}e$		$-\frac{1}{T^2_{\leftrightarrow}}K_{1u}\ f$			$-\frac{1}{T_g}$				
$-\frac{1}{T^2_g}K_{1J}\ n$		$-\frac{1}{T^2_{\leftrightarrow}}K_{1J}m$				$-\frac{1}{T_g}$			
$-\frac{1}{T_g^2T_a}K_{1f}\ p$		$-\frac{1}{T_{\leftrightarrow}^2T_a}K_{1f}\ r$					$-\frac{1}{T_g}$	$-\frac{1}{T^2_g}K_{1f}$	
$-\frac{1}{T_a^2}p$		$-\frac{1}{T_a^2}r$						$-\frac{1}{T_g}$	
			$-\frac{1}{T_{\text{哯}}^2}K_{\text{哯}}$						$-\frac{1}{T_{\text{哯}}^2}$

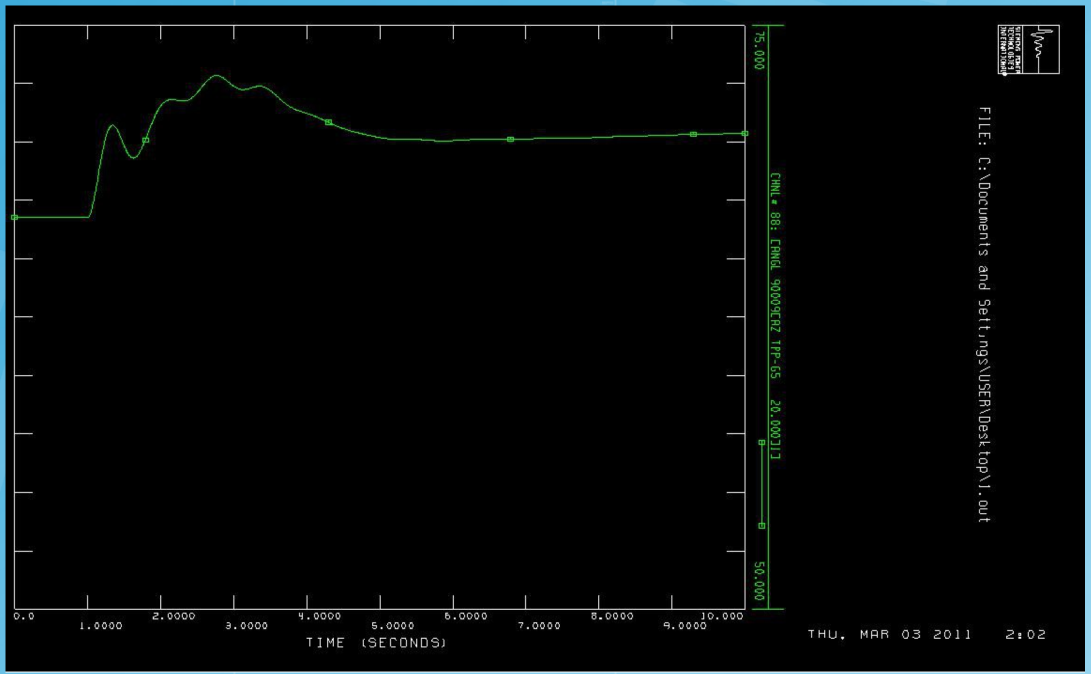
$$y(tx_i) = y(tx_{i0}) + \frac{\partial y(tx_{i0})}{\partial x_i} \Delta x_i + \sum_{k=2}^{n} \frac{\partial^k y(tx_{i0})}{\partial x_i^k} (\Delta x_i)^k$$

where $\frac{\partial y(tx_{i0})}{\partial x_i}$ - function of sensitivity

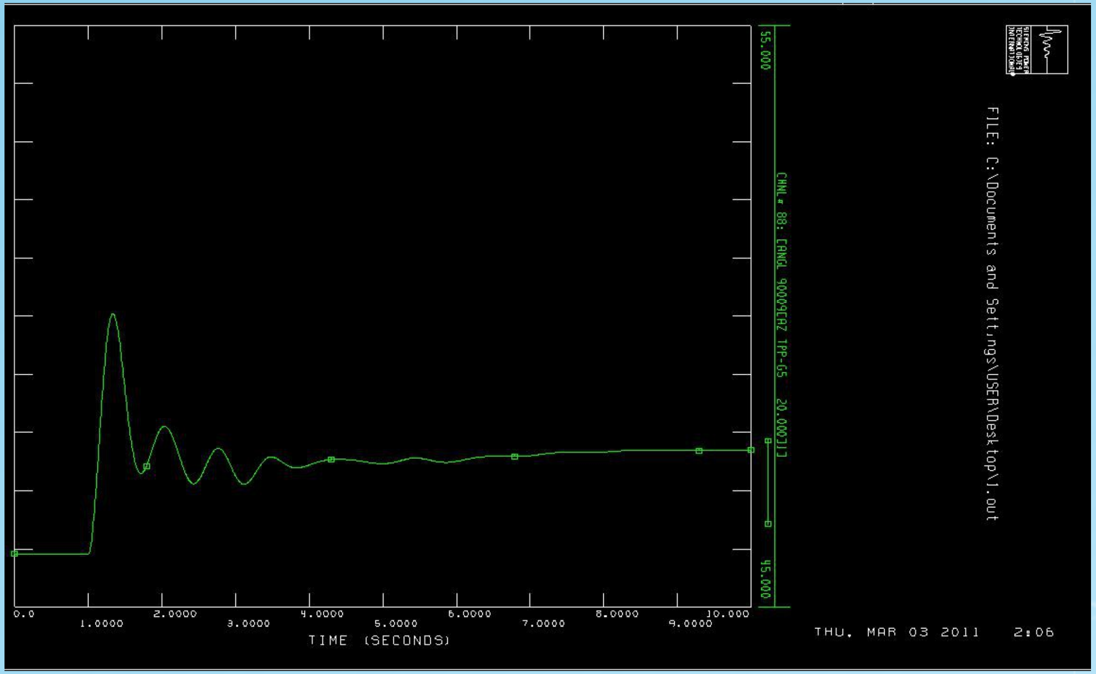
ELECTRICAL SCHEME OF "PG AGT"



Disturbance : Switching off both OVLAzTPP Goranboy 330KV without switching on angle of AzTPP concerning Borchka



Disturbance : Switching off both OVLAzTPP – Goranboy 330KV without switching on angle of AzTPP concerning Ingury



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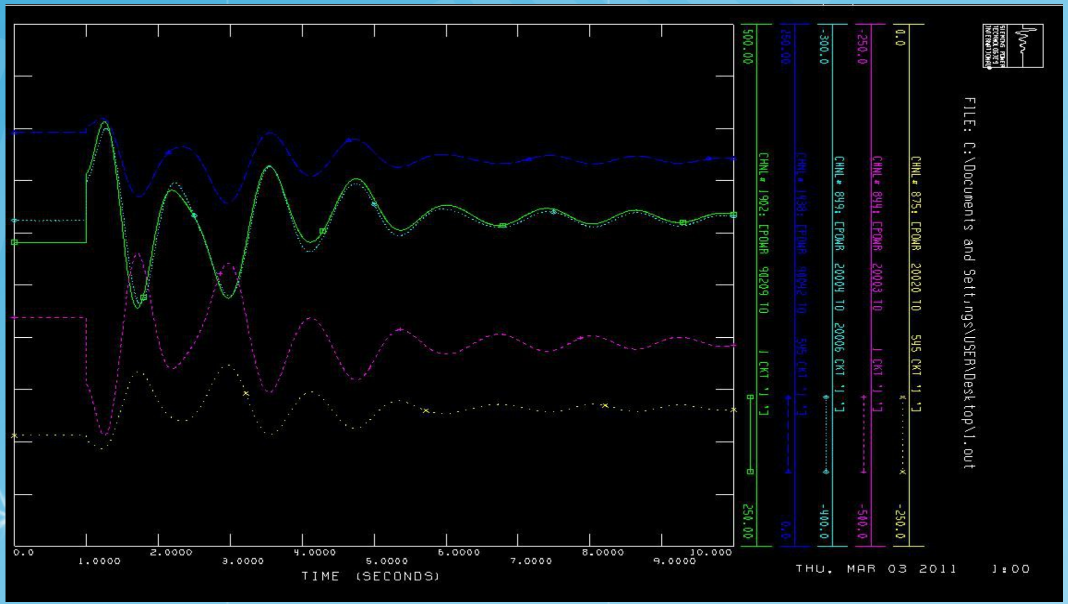
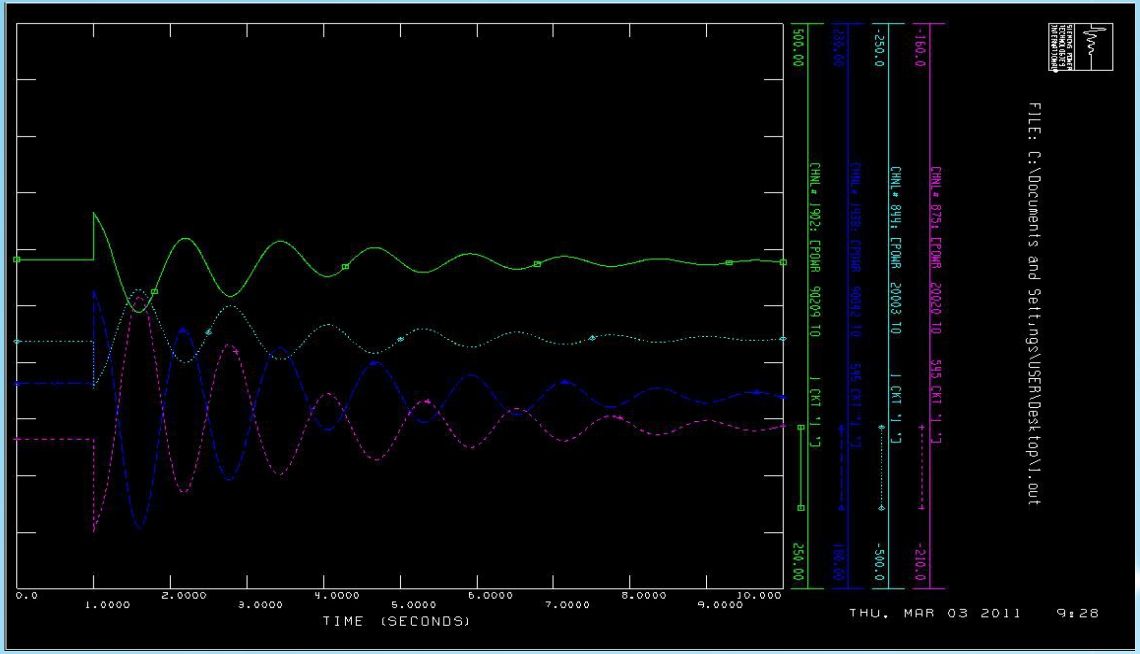
Disturbance : Switching off OVLAzTPP-Absheron 500 Kv without switching on (20). Power interchange on lines of Samukh-Gardabani 500 Kv , Akhstafa-Gardabani 300 Kv, Akhalsıkhi-Tskhalty 500 Kv (Georgia), AZ-Gardabani-500 KV (Georgia), AZ-Gardabani 330 KV (Georgia)

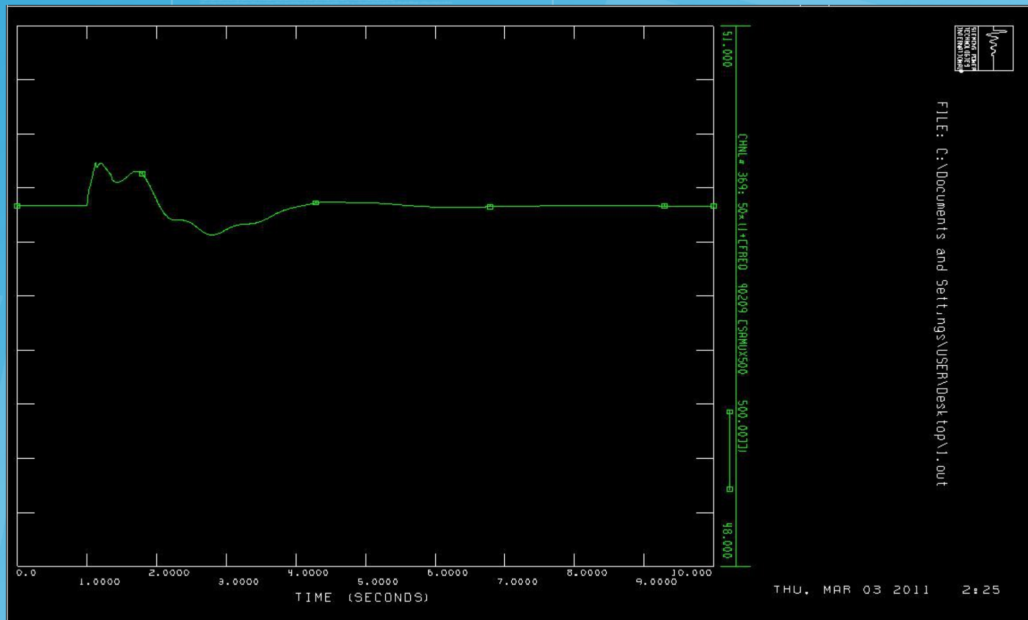


Disturbance: Switching off OVL Akhalsıkhi-Tskhalty 550 KV without switching on (44).

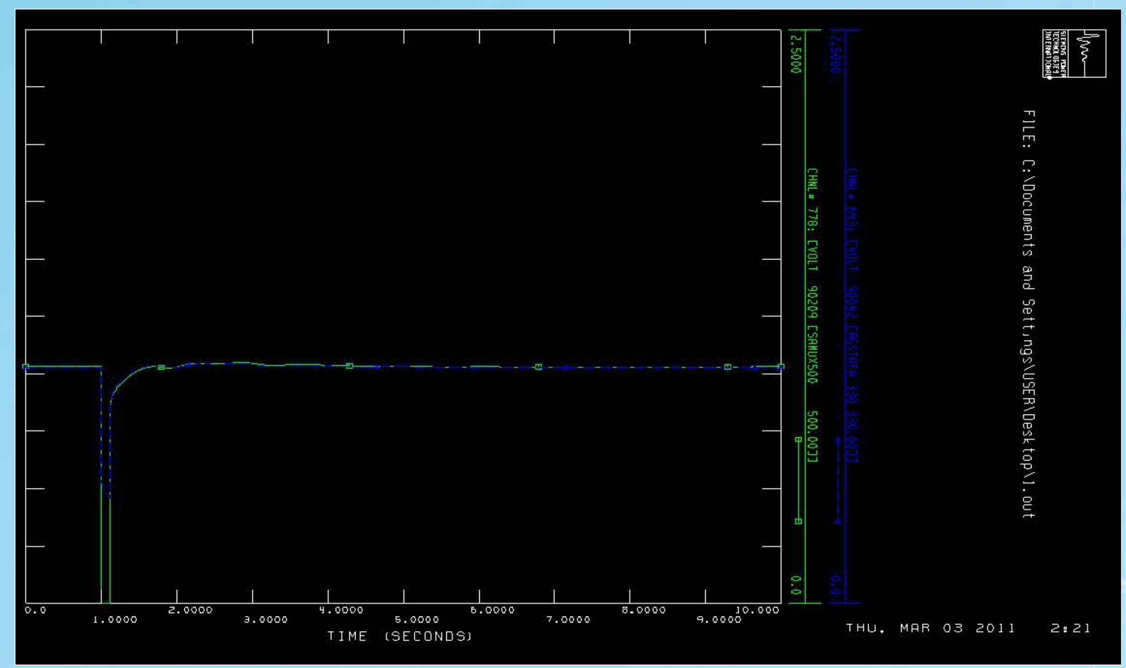
Power interchange on lines of Samukh-Gardabani 500 KV, Akhstafa-Gardabani 330 KV



Disturbance : 3rd short circuit on Samukh 500 KV bus with time delay t=0,12 sex (39).
Freqnency on Samukh 500 KV bus.



Disturbance : 3rd short circuit on Samukh 500 KV bus with time delay t=0,12 sec (37). Voltage on Samukh 500 KV bus, Akstafa 330 KV



CONCLUSION

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Comprehensive implementation of SCADA and PMU, coupled with high technology means for communication of information, management tools, are means of "Anti- Emergency Automatics", modern means of the electric power "accounting" at all levels led to the creation of intellectual control system

For effective "Anti - Emergency Management" is important for the solution of the problem optimal location of hardware intellectual technology. The answer may be obtained on the basis of a theory of measurement and sensitivity.

Example of the results of the pre-project studies on "PB AGT" shows the capability of controlling and transition processes in this regard by using simultaneous measurement of the complex voltage and current PMU at the end of the ties.

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